Analyzing semantic-pragmatic processing of scalar implicatures in typically-developing children

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by

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Abstract

This research examines the use of the quantifier "*some*" in English. Past research indicates that both semantics and pragmatics, or the context of the situation, dictate the meaning of the word. Previous work has shown that features that matter for the interpretation of the quantifier include syntactic context (downward entailing vs. non-downward entailing) and pragmatic context, for determining whether a scalar implicature meaning "some, but not all" will be associated with it. Less attention has been paid to the phonological properties of the quantifier, which turn out to be capable of determining its meaning by themselves. These properties include whether a full or reduced vowel is produced and whether or not a pitch accent is associated with it. For example, the vowel-reduced version, *sm*, implies an existential or "logical" interpretation of *some*. This can be interpreted as a "some and possibly all" meaning. Another, spoken with a L+H* pitch accent, *SOME*, has a pragmatically influenced "some, but not all" conversational, scalar, quantity implicature. The final variation, *some*, holds an intermediate status, has a full vowel, unlike *sm*, but lacks a pitch accent, like *SOME*, and may or may not occur with an implicature. A question that does not appear to have been asked before is what happens when an existential quantifier, such as *some*, marked with a L+H* pitch accent, occurs in an implicature-cancelling downward-entailing environment, such as the antecedent of a conditional sentence. Does the grammatical context "win" and cancel the implicature, or does the prosodic contour "win" and generate the implicature? Further, given earlier findings that preschool children pay attention to a quantifier's duration rather than its pitch, at which age do children become adult like? To answer this question we used a Truth Value Judgment Task in a between-subjects design with six groups (3 groups of adults, n=113 ; and 3 groups of children n=92 , age range=4;0–8;8, mean age=71 months, SD=12.39 months). Tentative conclusions are

that adult interpretations are influenced by both pitch accent and grammatical context. Children appear to largely disregard pitch and attend to duration.

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Chapter 1- Introduction

1.1 Introduction

Pitch accents can be used to signal a "some, but not all" conversational, scalar implicature associated with the existential quantifier *some*. Autosegmental Metrical Phonology (Beckman & Pierrehumbert 1986) describes what is referred to as a L+H* (read "low plus high star") intonational contour that signals a connection between the conversational common ground and the expression marked with this contour. At the semantic level, a fundamental property of conversational implicatures is that they can be canceled (Grice 1975). Chierchia et al (2001) explains that this cancellation can take place in specific grammatical contexts known as downward entailing environments, including the antecedent clause of a conditional sentence or in an expression produced with irrealis grammatical aspect. The combination of these two lines of observation is that there are grammatical contexts that tend to disallow conversational implicatures and phonetic markers that tend to signal them. A question that does not appear to have been asked before is how adult English-speakers interpret an existential quantifier, such as *some*, marked with a L+H* pitch accent, when it occurs in an implicature-cancelling downward-entailing environment, such as the antecedent of a conditional sentence. Does the grammatical context "win" and cancel the implicature, or does the prosodic contour "win" and generate the implicature? Further, what do children learning English as a first language do with these contexts? Providing an empirical answer to these two questions is the core of this thesis project.

1.2 Gricean Pragmatics

Grice (1975) develops a series of "maxims" or rules that form the basis of modern linguistic pragmatics, describing how cooperative speakers put language to use in context to

communicate. From the Cooperative Principle defined by Grice, rules or "Maxims" of Quantity, Quality, Relation, and Manner seem to be observed by all parties of a conversation. However, in the case of a conversational implicature, Grice acknowledges potentially ambiguous meanings and interpretations dependent on context. Gazdar (1979) similarly describes implicatures as the implied meaning of an utterance, without rigid written or linguistic definition. With pragmatic inferences, there exists an openness to the possibilities of implications between two interpretations, influenced by the context surrounding it. Grice's Maxim of Quantity requiring communicators to "make your contribution as informative as is required" yet "do not make your contribution more informative than is required" (Grice 1974, p. 48) guides meaning behind implicatures. It is possible to represent the features of the conversational implicature associated with the existential quantifier *some* in action:

(1) Some of the girls skipped rope.
(2) Not all of the girls skipped rope.
(3) Some, in fact all, of the girls skipped rope.
(4) All of the girls skipped rope.
(5) Some of the girls skipped rope, but not none.

The baseline (1) allows an implicature similar to the interpretation of (2), while the additional clause entailment "in fact all" in (3) cancels the implicature, and (1) is compatible with (4) but (4) would not be fully felicitous in the presence of the implicature as it is withholding information, violating the Gricean maxim of Quality. Similarly (5) supplies overemphasis and would be rejected according to the Gricean maxim of Quantity.

1.3 Pitch Accents and Conversational Implicatures

In his influential (1974) work *Language and Consciousness*, Chafe provides a useful overview of the interaction between intonation and implicatures. Chafe (1974) asserts that cues

such as pitch accents are pivotal to the shared quality of consciousness in language between two or more speakers in conversation. The dependence on one another to effectively communicate makes both the speaker and the listener aware and respectful of the other's stream of consciousness when exchanging information. There are a variety of reasons why a speaker would utilize a stressed word and the inference that comes with it. The two most prominent uses of pitch occur when new information and the contrasting of two entities arise in conversation.

New Information

With respect to new information, Cruttenden (1997) points out that a speaker can use pitch on particular words in an utterance to denote special attention to the receiver, and can also use low pitch on words that the speaker assumes the listener has within their consciousness.

(6) Speaker 1: Did you have a nice time at the park?
(7) Speaker 2: I had a *miserable* time at the park.

Speaker 2 chose to emphasize the word "*miserable*" in this example because it is the new information to Speaker 1's stream of consciousness. Speaker 1 already has the old information of Speaker 2 going to the park; therefore it is reasonable to say that the most important component of Speaker 2's utterance was the new knowledge of the type of day he experienced (Cruttenden 1997, pp. 74-81).

Contrast

Cruttenden (1997) additionally asserts that stress concentration can be used with old information between contrastive items that fall within a limited set in the scope of focus. Information sets that are not binary, or involve more than two pieces of information, typically have an implicit meaning rather than explicit.

(8) I have an *Asus* laptop

If (8) is said during a conversation about laptop manufacturers, it appears to diverge from other potential laptop companies within that particular scope, yet the contrast is unspoken (Cruttenden 1997, pp. 82-84). In a similar manner, Halliday (1967) asserts that if a speaker chooses to place tonal stress or focus on a particular unit of information, the listener will not only increase attention to it, but also negate the potential alternatives to come to the same intended meaning of the speaker.

(9) *Helen* will be joining the Navy this summer.

The pitch emphasis on the name "*Helen*" in (9) implies that the answer to the unspoken question: "Who is joining the Navy this summer?" is not Billy, Henry, or any other person in question.

In summary, our research will be examining controlled variations in pitch accent of the quantifier *some* in English speech. With this particular quantifier it is important to identify the implicatures associated with the differences in pitch. The first vowel-reduced *sm* (cf. Postal 1964, Milsark 1977) tends to convey an existential or "logical" interpretation of the quantifier. Another, spoken with a L+H* pitch accent, *SOME*, has a pragmatically influenced "some, but not all" meaning, constituting a pragmatic, scalar quantity implicature. The final variation, *some*, holds an intermediate status, has a full vowel, unlike *sm*, but lacks a pitch accent, like *SOME*, and may or may not occur with an implicature, dependent on context.

1.4 Cancellation of Implicatures in Downward Entailing Environments

In Levinson's (1983) work on pragmatic implicatures, he combines knowledge of deixis, presupposition of language users, and speech structure to note the ability of implicatures to be non-detachable from the linguistic component of the utterance, but attached to the semantic

content. In these situations an implicature should remain the same between sets of expressions with the same meaning, but if the implicature is pivotal to the information within the utterance then there is confusion as to how it can be non-detachable. For example, the sentence with the scalar implicature (10) could imply (11), however there can also be truth in its agreement with (12) as well.

(10) Some leaves fell to the ground.
(11) Not all of the leaves fell to the ground.
(12) Some and maybe all leaves fell to the ground.

Chierchia et. al (2001) explains the arrangement of scalar implicatures on a scale of 'quantity' based on the amount of information given to the interlocutors in a conversation. Logical words such as *or* and *and* construct a subset/superset relationship in which *or* entails *and*, however, one would not use *or* if they have knowledge of the situation that could lead them to instead use the superset *and*. For example, it is assumed a cooperative speaker attending to Grice's maxims would say (14) not (13) in a situation about Sam's interests, if Sam likes both dogs and horses:

(13) Sam likes dogs or horses.
(14) Sam likes dogs and horses.

The exclusive interpretation of *or* in (13) supplies more information and leads listeners to believe either of the first two of these sentences, but not both, (15a, 15b) to be accurate, however (15c) would be incorrect.

(15a) Sam likes dogs.
(15b) Sam likes horses
(15c) Sam likes dogs and horses.

When *or* is used in a downward entailing environment, in this case in the antecedent of a dependent clause, it renders an inclusive-*or* interpretation of the quantifier, and does not allow a

scalar implicature to arise. In the following example, (16) allows the interpretations of (17a) and (17b).

(16) If Mark or Ted leave her party, Sarah is sad.
(17a) If Mark leaves her party, Sarah is sad.
(17b) If Ted leaves her party, Sarah is sad.

Another example of a downward entailing environment occurs when negation applies to the context. In this situation, there is licensure of inferences from supersets (*and*) to subsets (*or*). Only in a downward entailing environment is it possible to infer upwards, against the current of Gricean maxims. In declarative positive situations, the licensing of inferences can only transfer from sets to supersets.

(18a) Some frogs jumped in the pond.
(18b) All frogs jumped in the pond.
(19a) If some frogs jumped in the pond, Henry will cry.
(19b) If some, and possibly all, frogs jumped in the pond, Henry will cry.

For example, (19b) could be inferred accurately from (19a) due to its placement in a downward entailing environment, from the subset "some" to the superset "all". However (18b) is not entailed by (18a) because its placement in a declarative context warrants inferences from the superset "all" to the subset "some". (Chierchia, 2001, p158)

Crain et al (2000) explores the subset/superset relationship of logical quantifiers to children's language in relation to adult language. In summation he states that children who follow the same pragmatic rules of conversation that adults adhere to should "imply, but not entail, exclusivity, and their use of *some* will imply, but not entail 'not every'." (Crain 2000, p. 3). His research on the ability of children to interpret logical expressions with the quantifiers *or* and *some* concludes that they adhere to the classic logic in semantics exhibited by adults and they also are aware of the pragmatic weight of conversational implicatures.

1.5 Children's Knowledge of Pragmatic Implicatures

Braine and Rumain (1981) focused on children's abilities to compute conversational implicatures with the logical elements *or* and *and*. Their experiment asking children to "pick a red or blue balloon" was presented in a situation that did not cancel implicatures. Consequently, participants interpreted them to be "exclusive" *or* meanings (e.g. "red or blue, but not both") and not as the "inclusive" or, which means "red or blue or both", which is the same as *and*. They concluded children were unable to understand either the logical interpretation, or the pragmatic interpretation of quantifiers due to their choice of either one red or one blue balloon (Crain, 2000, pp.4). Thus, Braine and Rumain were unable to examine children's knowledge of logical elements because their tasks did not control for the generation of pragmatic implicatures.

Similarly, Johansson (1977) attempted to examine child and adult interpretations of the the conjunctions *or* and *and* to determine whether they were able to access their logical meanings. Due to a similar failure to control for implicatures, children were led to infer solely the exclusive meaning of *or*, rather than the inclusive meaning *and*. Although Johansson's (1977) results concluded child participants were unable to access the logical meaning of the quantifiers in question, the ambiguous method of testing did not allow children to recognize the need to cancel the implicature attached to the quantifier.

Other work, in contrast, has concluded that children are better at accessing semantic or logical interpretations and struggle with pragmatically enriched interpretations. Noveck (2001) claims that children as old as seven years are unable to generate pragmatic implicatures in French. In using situational statements that were contextually ambiguous such as "*Some* giraffes have long necks" (Noveck, 2001, p. 170), Noveck concluded children were unable to reject true statements that were pragmatically infelicitous. He insisted that if they understood Grice's

pragmatic maxim of cooperation, they would have only accepted the more felicitous statement "*All* giraffes have long necks". The statements used in his experiment lacked context and need to be ruled as inconclusive data for the ability of children to understand pragmatic rules on implicatures. In response to Noveck, Papafragou and Musolino (2003) show that children at the age of seven are in fact able to generate implicatures, when experiments provide sufficient pragmatic context.

Research considered thus far, however, does not take into account the role of intonation. In later research with Greek-speaking children, Papafragou & Tantalou (2004) were the first in studies of child semantics and pragmatics to carefully use the Greek term for *some*, "meriki", with a contrastive stress. They recorded that situations in which a weaker scalar term was used rather than the desired target scalar term, children correctly rejected the statement with reasoning following Grice's maxim of quantity (Papafragou & Tantalou, 2004). This was further confirmed by Miller et. al (2005) which concluded contrastive stress played a crucial role in implicature generation and that children were less inclined to generate an implicature when the word was not given any pitch accent. This study was the second contrastive stress experiment in English to use a stressed "some". Additionally, her data with Spanish speaking participants showed "algunos" was interpreted like the stressed "some" without having contrastive stress actively placed on the word.

In response to the Noveck (2001) experiment with true but pragmatically infelicitous statements, Guasti et al (2005) improved the experimental expectations of child participants with Italian children of seven years (the youngest age in Noveck's participants) using a Truth Value Judgment Task (TVJT) methodology. In focusing on the scalar quantity *some*, Guasti et al showed children could understand scalar implicatures in natural conversational situations.

Children rejected underinformative uses of the quantifier *some* at an almost comparable rate to the adults. In situations where the desired outcome is unknown, children allow pragmatics to dictate the meaning, while in a context with a certain outcome, semantics governs the interpretation. Neither of these studies took the component of intonation of the scalar implicature into account.

In Spanish, existential quantifiers seem to be organized differently than in English. Vargas-Tokuda et al (2009) shows that children as young as 5 years-old are comparable to adults in their calculation of implicatures relative to the English quantifier *some,* with the Spanish existentials *unos* and *algunos*. While *unos* elicited a "some but not others" connotation that could not be canceled in downward- entailing environments, *algunos* implied a pragmatically generated "some but not all" meaning that could be canceled in downward-entailing environments. In using a TVJT to test children's awareness of the semantic and pragmatic influence on the scalar implicatures *unos* and *algunos*, it was determined they are able to calculate subtle differences in meaning dependent on the surrounding context. Intonation was not a variable manipulated in these experiments, but the results were nonetheless quite categorical, suggesting that intonation may not be critical to the expression of pragmatic implicatures in Spanish, as they seem to be in English.

Chevallier (2009) examines the performance of a group of children diagnosed on the Autism Spectrum Disorder (ASD), which, at the time, included Asperger Syndrome (AS). In general, individuals with ASD are thought to struggle with language development deficiencies that can range from severe to nearly undetectable dependent on the form of the ASD. In order to learn more about the ability of children with AS compared to children with typical development, Chevallier et. al participants consisted of males around the age of fourteen that had either been

diagnosed as having AS or diagnosed as being typically developing as the two groups of participants within the study. Several closely controlled experiments focused on both accuracy and reaction time relevant to the grammatical function of prosody. Participants showed an ability to distinguish pitch, duration, intensity and different prosodic contours. The results of Chevallier found that in all cases the difference between the findings of children with AS and typically developing children were indistinguishable, meaning the ability to distinguish grammatical prosody is typical in individuals with Asperger Syndrome at the age of fourteen.

Grinstead et al (2010) and Thorward (2009) focus on identifying the impact of stress and duration on children's interpretations of existential quantifiers produced in both implicature generating and implicature canceling (downward entailing) syntactic environments. The between-subjects design Truth Value Judgment Task with children ranging from ages 4-6 and an adult control group was the first that specifically controlled the pitch and duration of stimuli with consistent values for word duration, vowel duration, and maximum pitch. The three variants of *some* presented to participants varying in vowel presence and pitch accent presence, was presented in both an implicature generating context and also implicature canceling context. They asked how children would perceive a pitch accented form of *some* in a downward entailing environment, but did not focus on the adult results. Their results showed that in the latter environment adults will generate an implicature more in comparison to the non-pitch accented forms (*sm*, *some*), but fewer in comparison to an implicature generating environment. In order to ask the same question of preschoolers, it first needed to be established that controlled contrastive pitch impacts the implicature generation in an adult-like way. Data shows children did not rely heavily on pitch, and a similar number of implicature were generated for the pitch accented forms relative to the non-pitch accented forms. However, the differences in the forms' durations

were found to dictate if an implicature was generated. The longer forms with a vowel present, (*some, SOME*) were associated with implicatures, unlike the form without a vowel (*sm*). When the question of implicature cancellation in downward entailing environment was asked of preschoolers, the data produced uninterpretable results.

Two questions that emerge, then, from the work reviewed are what the interaction of pitch accent and downward entailing syntactic context produce, with respect to the "some, but not all" pragmatic implicature for adults and at what point do children begin to pay attention to pitch as well as duration in their interpretations of *some,* as do adults.

1.6 Research Questions

Unlike other studies, ours specifically focuses on the influence of the grammatical context compared to the influence of the prosodic contour with the quantifier "some". Using a TVJT to judge child and adult computation of implicatures, the more important factor, either pitch or the downward entailing environment, will generate the appropriate implicature. Also, there will be a special attention given to the timed reaction of children learning English within each of these contexts, as a measure of working memory.

The questions asked within our study will further contribute to the understanding of child language development in English.

1. Which interpretation of a quantifier will arise when a pitch accent occurs in a downward entailing environment?
2. At what age do typically-developing English-speaking children successfully compute and cancel scalar implicatures similar to adults?

Chapter 2: Experiment 1: Adult Use of Existential Quantifiers

2.1 Methods

Participants: 35 English-speaking adults (age range= 18 years to 22 years, mean age= 20:3 years) from the Ohio State University's campus, all of whom signed an informed consent document approved by OSU's Institutional Review Board. Adults were required to pass two control tests with the quantifiers "all" and "none" and complete a background questionnaire. This information ensured each participant had normal hearing, no language delay concerns, and had proficiency only in their L1.

Materials: To evaluate adults' interpretations of the distinct variants of the existential quantifier *some,* a Truth Value Judgment Task was presented on a computer monitor using headphones. The experiment software, EPrime, records both participants' responses and reaction times. The categorical variable, accuracy, measured 'yes' and 'no' responses. These were recorded as 1 for acceptance and 0 for rejection. The continuous variable, reaction time, measured the time taken to respond to the yes-no question given at the end of the TVJTs. These were recorded in milliseconds.

Procedures: Adults were required to answer training questions with the scalar quantities of "all" and "none" that were required for the participant to be included in this study. No adults were excluded for failing to answer these TVJT training questions correctly. Participants watched the TVJT video with headphones and responded to the questions as quickly as possible with either a "yes" or "no" response. Participants' fingers are at a set start distance of 2.25 inches from the

center of the response box, and are instructed to answer only after the question has been completed.

Stimuli: There were four target sentences with either 3 or 4 of 4 animals jumping over a fence. Two of the four target sentences appeared in a downward-entailing environment (the antecedent of a conditional). There were two control sentences with either 0 of 4 or 3 of 4 animals jumping over a fence, utilizing the words "all" and "none". Additionally, there were two training sentences with 4 of 4 or 3 of 4 animals jumping over the fence, also using the words "all" or "none". Each set of participants was shown a video containing a single version of *some*.

Example for non-DE context:

Experimenter: This is Sam (introduce lion puppet). Sam loves to play games. His favorite game to play is the barnyard game. Sam is going to watch what goes on in the barnyard, and in the end, tell you what he sees. Your job is to tell me if what Sam said was right. Let's watch!

Experimenter moves 3 of 4 or 4 of 4 animals to jump over the fence towards the barn.

Sam: I know what happened! Sm cats jumped over the fence!

Experimenter: Is that right?

Example for DE context:

Experimenter: Now we're going to play a new game with Sam (indicate lion puppet) and Bill (introduce panda puppet). Sam and Bill love to watch what goes on in the barnyard and tell you what they see. In the end, you get to decide who's right. Let's watch!

Sam: Let's play a game!

Bill: OK

Sam: This time, if sm cats jump over the fence, you have to give me a quarter!

Bill: OK!

Experimenter moves 3 of 4 or 4 of 4 cats to jump over the fence towards the barn.

Sam: Now you have to give me a quarter!

Bill: No I don't.

Sam: Yes you do! I said, if sm cats jump over the fence, you have to give me a quarter!

Experimenter: What do you think? Should Bill give Sam a quarter?

Training sentences:

(6) All of the donkeys jumped over the fence (4 of 4 jump)

(7) None of the roosters jumped over the fence (3 of 4 jump)

Control Sentences

(8) None of the cows jumped over the fence (0 of 4 jump)

(9) If all of the zebras jump over the fence, you have to give me a quarter (3 of 4 jump)

Target Sentences

(10) Sm/Some/SOME monkeys jumped over the fence (3 of 4 jump)

(11) Sm/Some/SOME cats jumped over the fence (4 of 4 jump)

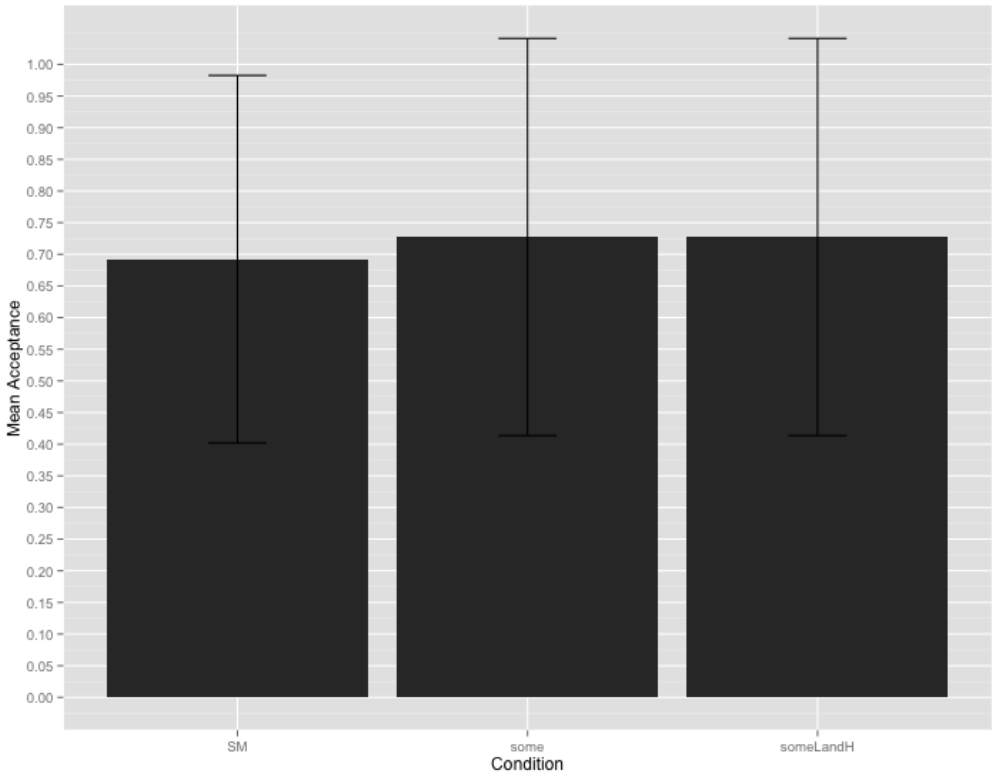
(12) If sm/some/SOME pigs jump over the fence, you have to give me a quarter (3 of 4 jump)

(13) If sm/some/SOME elephants jump over the fence, you have to give me a quarter (4 of 4 jump)

For each video, there was consistency in the particular target sentence used for each of the scenarios and the type of animal that paired with it. The sole difference between the videos was the condition of *some* used in the sentence (sm/some/SOME).

2.2 Results

In the implicature canceling environment, adults canceled implicatures with a pitch accented SOME, though not significantly more or less than with the other two types ($p > .05$).



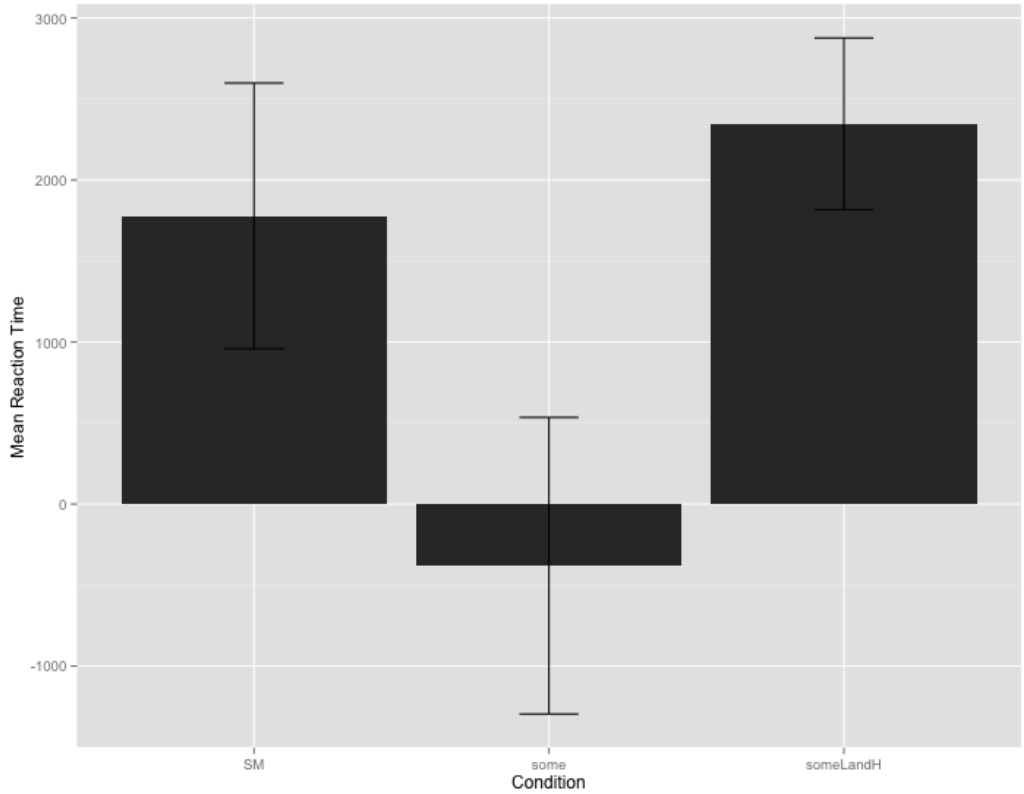
Graph 1. Adult Acceptance - Implicature Canceling Context

The following table gives the breakdown of the adult answers to the TVJT in the condition they were assigned to, implicature generating contexts.

Percentage of Responses when 4/4 Animals Jumped in Downward Entailing Contexts					
sm		**some**		**SOME**	
Accept	Reject	Accept	Reject	Accept	Reject
69.23%	30.77%	72.73%	27.27%	72.73%	27.27%
9/13	4/13	8/11	3/11	8/11	3/11

Table 1 – Adult Judgment of Implicature Generation with Quantifiers in Downward Entailing Context with 4 of 4 Animals Under Consideration Jumping

With respect to reaction time, adults seem to process the standard variant of *some* (no pitch accent, but with a full vowel) in downward entailing environments, faster than the two phonetically marked versions *sm* and *SOME* (1-way ANOVA, $f(2)=15.739$, $p < .001$). Adult data shows the variant *some* is faster than *sm*, $p < .001$, and faster than *SOME*, $p < .001$, by post-hoc test.



Graph 2. Adult Reaction Time – Implicature Canceling Context

2.3 Discussion

To answer the question 'Which interpretation of an implicature will arise when a pitch accent occurs in a downward entailing environment?' adults, in this data, did not appear to cancel implicatures less as a function of the phonetic cues of duration and pitch. There was however a difference in their reaction times showing their response times were much shorter with the standard version of *some* than either of the phonologically marked versions. This raises a new question about the processing time of phonetic cues of pitch and duration slowing adult interpretations. Further work will be required to understand why *some* is processed so much faster than the other two variants (*sm* and *SOME*).

Chapter 3. Experiment 2: Child Use of Existential Quantifiers

In this experiment, we ask the question of whether children slightly older than the preschool-aged children tested in Thorward (2009) or Grinstead et al (2010) will begin to approximate adult-like answer patterns.

3.1 Methods

Participants: A sample of 53 children were recruited for our experiment from various after school programs, schools, and camps in the central Ohio area. Each participant's guardian signed an informed consent document approved by OSU's Institutional Review Board. Additionally, the children were asked for their assent to participate at each visitation from a research assistant. To be included in the sample, children were required to fall within one standard deviation from the mean on two standardized tests, the CELF-4 (Clinical Evaluation of Language Fundamentals, 4th edition) and KBIT 2 (Kaufman Brief Intelligence Test, 2nd edition). The guardian for each child

completed a Background History Form ensuring all participants were monolingual, typically developing children with normal hearing and there was no concern about the child's development, including being on the Autism Spectrum. The average of total years of education of parent/guardians of participants was 17.83 years. The total number of excluded participants was 30. Six children were excluded for failing the test filler trials. Another nine participants failed to score within one standard deviation on the CELF 4 and KBIT 2 scores. Ten children declined to complete the standardized testing process. Three participants were excluded for receiving speech therapy in the past. Finally, two participants were excluded from this data due to their diagnosis on the autism spectrum, but their data may be included in future studies on this existential quantifier. The final sample resulted in 23 English-speaking children (age range=71 months to 107 months, mean age=84.3months)

	KBIT2			CELF4		
	Mean	Range	SD	Mean	Range	SD
Sample (n=23)	105.7083	134	13.93959	110.5217	36	9.806628

Table 2 – Mean Scores By Age of Participants On The KBIT2 and the CELF4

Each participant was assigned to one of three groups in our between-subjects design, corresponding to one of the three variants of *some* tested. There were 7 children in the *sm* group, 10 children in the *some* group, and 6 children in the *SOME* group. In addition, an adult control group consisting of 13 adults in the *sm* group, 11 adults in the *some* group, and 11 adults in the *SOME* group was tested.

Materials: Two standardized tests, the CELF-4 and KBIT 2 were administered to control for the participants' nonlinguistic cognitive level. These tests will be useful in the future for matching our typically-developing results to those of children on the autism spectrum. The particular subtests within the CELF-4 were chosen to determine the presence of a language disorder or delay. The subtest of 'Concepts and Following Directions', 'Word Structure', 'Recalling Sentences', and 'Formulated Sentences' compose the Core Language Score of the CELF-4. The scaled scores of the Core Language portion indicate an individual with disordered language performance. The KBIT 2 assesses an individual's intelligence and reasoning. The subtest chosen for this study was the 'Matrices' portion. This nonverbal subtest includes meaningful and abstract stimuli. The questions require the participant to use their nonverbal reasoning and problem solving capability to understand the relationships between items.

The experiment was administered through the EPrime software on a computer monitor using headphones. EPrime recorded not only the participants' responses, but also their reaction time. The categorical variable, accuracy, measured 'yes' and 'no' responses. These were recorded as 1 for acceptance and 0 for rejection. The continuous variable, reaction time, measured the time taken to process the implicature and assign it meaning. These were recorded in milliseconds.

Procedures: The experiment consisted of 2 experimental sentences (one in an implicature-generating context and one in an implicature canceling context), 3 warm-up sentences to familiarize children with the format of the experiment, but using quantifiers other than those

tested and two filler sentences. In order to remain in the sample, participants had to get both fillers correct.

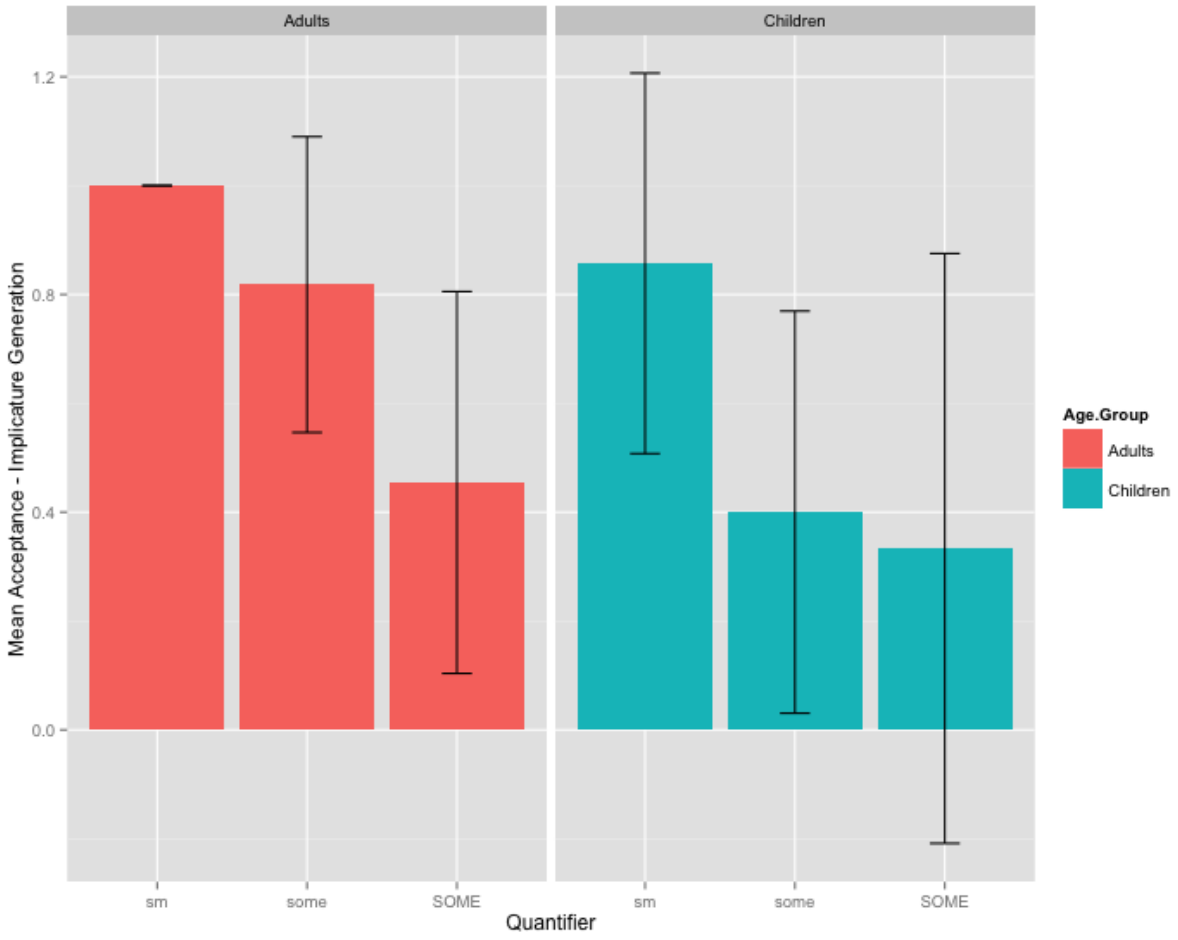
For children, the experimental video is prefaced with an activity from the test administrator. This ensures the participant understands the use of the "yes" and "no" buttons on the response box. Both the adults and the children started with their response finger at the same set distance from the response keys. Next, participants were required to answer the control questions through the EPrime program. These questions required them to correctly identify the number, color, and shape of pieces of paper shown by a researcher. Participants could view this video as many times as needed until the correct responses were recorded and the participant understood what was being asked of them.

Next participants watched the TVJT video with headphones and responded to the questions as quickly as possible with either a "yes" or "no" response.

Stimuli: The stimuli for the child experiment were matching those used for the adult experiment.

3.2 Results

Children are not different from adults in their judgments of *sm* and *SOME* in implicature generating contexts ($p > .05$), but are different with respect to *some* (chi-square (1) = 3.884, $p = .049$). As illustrated in the following graph, *some* and *SOME* appeared to pattern together from children and contrast with *sm*.



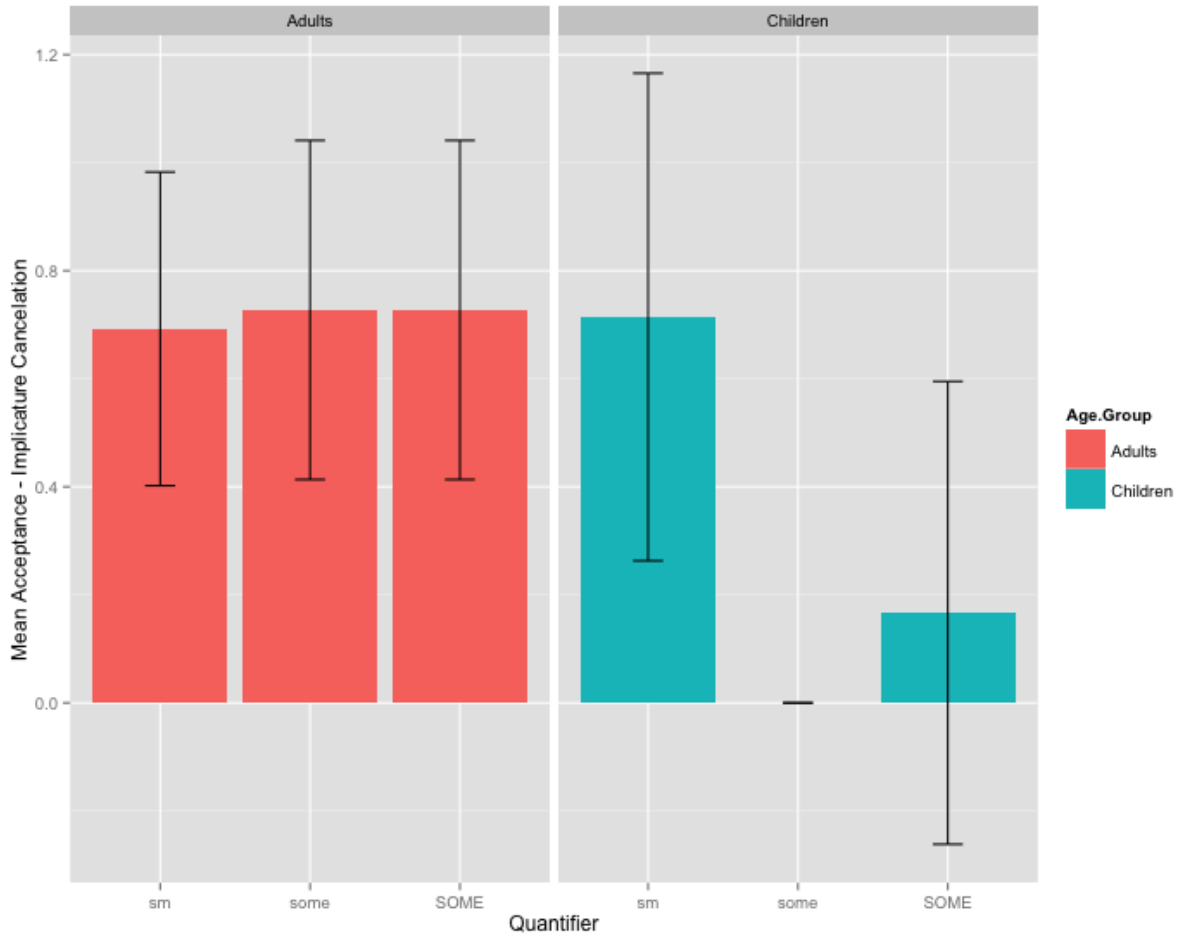
Graph 3. Adult and Child Acceptance in Implicature Generating Context

These results are similar to those of Thorward (2009), who argued that children paid attention to duration, in that long words (*some* and *SOME*) generate implicatures, while the short variant (*sm*) does not. The following table gives a detailed break down of the children's responses.

Percentage of Responses when 4/4 Animals Jumped in IG context					
sm		**some**		**SOME**	
Accept	Reject	Accept	Reject	Accept	Reject
85.71%	14.29%	40%	60	33.33%	66.67%
6/7	1/7	4/10	6/10	2/6	4/6

Table 3 – Child Judgment of Implicature Generation with Quantifiers in Implicature Generating Context with 4 of 4 Animals Under Consideration Jumping

Also similar to Thorward's preschool children, our 5-8 year-olds generate more implicatures in downward entailing contexts with *some* (chi-square (1) = 11.748, p = .001) and *SOME* (chi-square (1) = 4.898, p = .027) than adults do, but not with *sm* (p > .05).



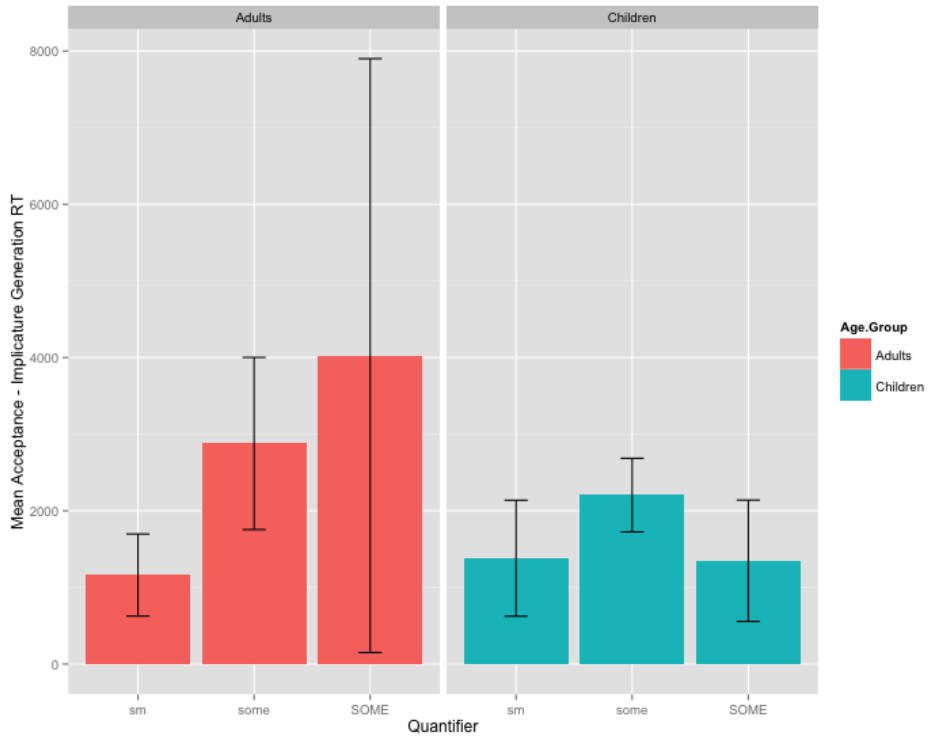
Graph 4. Adult and Child Acceptance in Implicature Canceling Context

The following table gives a breakdown of the children's responses.

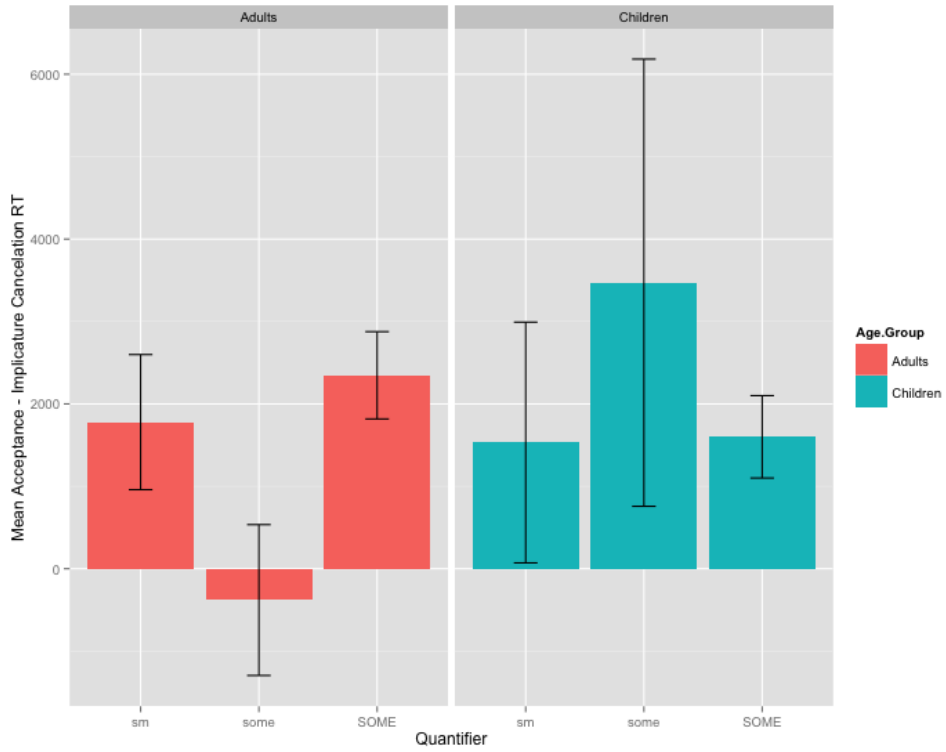
Percentage of Responses when 4/4 Animals Jumped in DW context					
sm		**some**		**SOME**	
Accept	Reject	Accept	Reject	Accept	Reject
71.42%	28.58%	0%	100%	16.67%	83.33%
5/7	2/7	0/10	10/10	1/6	5/6

Table 4 – Child Judgment of Implicature Generation with Quantifiers in Downward Entailing Context with 4 of 4 Animals Under Consideration Jumping

With respect to reaction time for adults, there were no significant differences in Implicature Generation among the three variants of *some*, in my data, but adults were significantly faster in Implicature Cancelation with *some* than they were with *sm* or *SOME* ($f(2)=15.739$, $p < .001$, also $p <.001$ for post-hoc *sm* vs. *some* and *sm* vs. *SOME*). For the children, in the Implicature Generation condition, *some* took significantly longer than either *sm* ($p = .035$) or *SOME* ($p = .036$). There were no significant differences in the Implicature Cancelation condition, yet the data appeared to trend in the same direction.



Graph 5. Adult and Child Reaction Times in Implicature Generation Context



Graph 6. Adult and Child Reaction Times in Implicature Canceling Context

3.3 Discussion

The accuracy results of this experiment with a roughly 7 year-old sample appear to be consistent with the results from Thorward's (2009) sample with 5 year-old children. It appears that within our age range, children still tend to depend on duration as a phonetic cue, rather than pitch, to signal pragmatic implicatures. Similarly to Thorward again, the roughly 7 year-old sample generated more implicatures in the implicature canceling condition than adults did, with the exception of the stimulus *sm*.

An interesting result is the difference in reaction time between adults and children with *some* in the Implicature Canceling condition. Since *some* is the most frequent variant of "some" (Thorward 2009), it is interesting that the children in our sample are so much slower than adults.

4.0 General Discussion

Past research on the existential quantifier *some* has failed to note the importance of both prosodic cues and duration for the meaning associated with the word in both implicature generating contexts and downward entailing or implicature canceling contexts. The research questions developed for this project then aims to clarify past work done by Thorward (2009) to determine which interpretation of an implicature will arise when a pitch accent occurs in a downward entailing environment for adults. Additionally, the work of Thorward (2009) concluded children ranging from ages 4 to 7 were not adult like in their interpretation of implicatures. To address the question of the age at which typically-developing children successfully compute and cancel scalar implicatures similar to adults, we continued research with children ages 5 to 8.

Our experiment addresses the research inquiries in question by using the most approved tool by past research of accurately showing what children know in a pragmatic environment. The control parameters on the group of participants ensured a monolingual, typically developing sample of 5 to 8 year old children. The use of EPrime and the video provided both reliable and accurate readings of acceptance of implicatures in certain environments.

Accuracy results from adults in a downward entailing environment suggest no differences, but a larger sample size is needed to have greater confidence in the observed pattern in processing the implicature. Additionally, it appears that children ages 5 to 8 are consistent with the younger children in Thorward's (2009) sample. They continue to rely on duration as a phonetic cue, rather than pitch, to signal pragmatic implicatures. It was determined that as in Thorward's preschool sample, our school-aged children created more implicatures in the downward entailing environment than adults, with the exception being the *sm* variant. This ability to look adult-like with *sm* in implicature canceling contexts is probably what underlies their apparently adult-like behavior in previous work (e.g. Chierchia et al 2001).

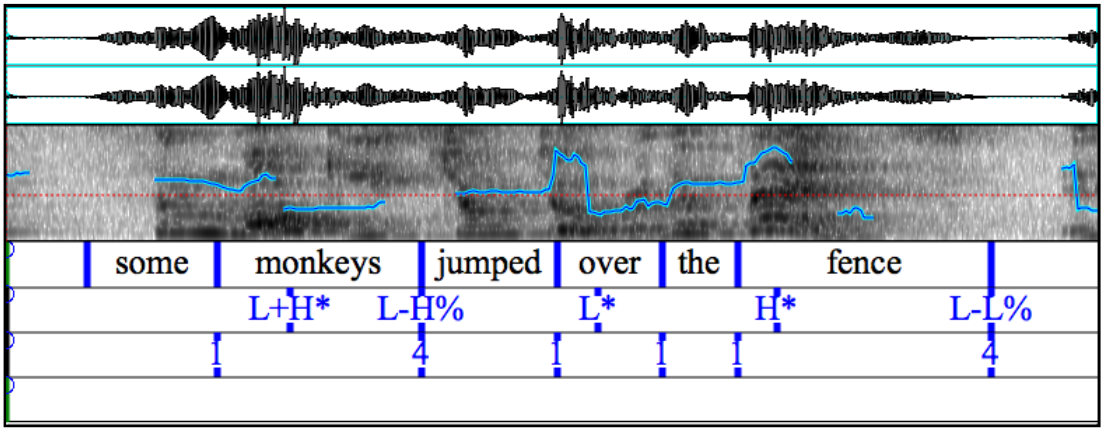
The future direction of this thesis should focus on a large, older child sample to determine if the next older age group would be more adult like in their acceptance/rejection of the existential quantifier in both implicature generating and implicature canceling contexts. Additionally, a larger sample of reaction time data must be collected. This new data with reaction times of children should be compared to adults to note any potential trends in the processing of the implicature in different contexts.

Appendix

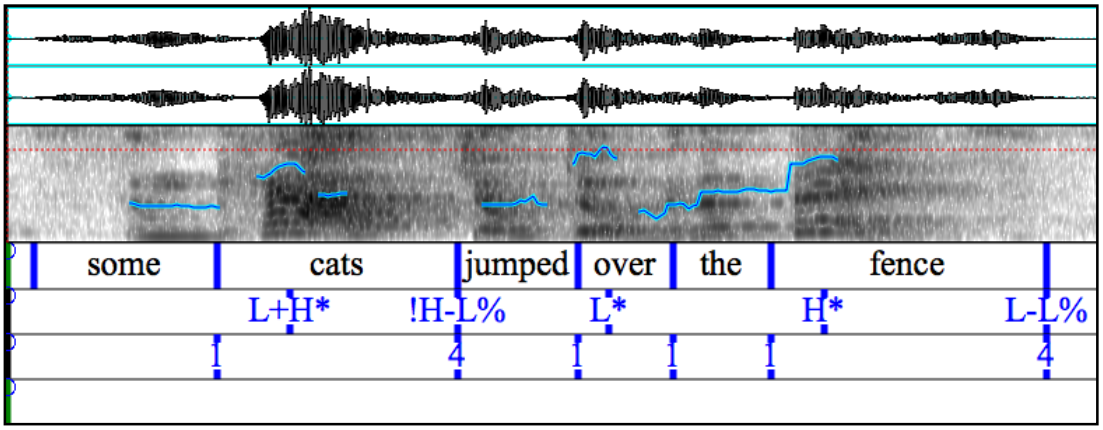
ToBi Transcription from Thorward (2009)- supplying annotation of prosody of recorded stimuli sentences in both the implicature generating environment (IG) and the downward entailing environment (DE).

<u>*Sm* stimuli sentences:</u>

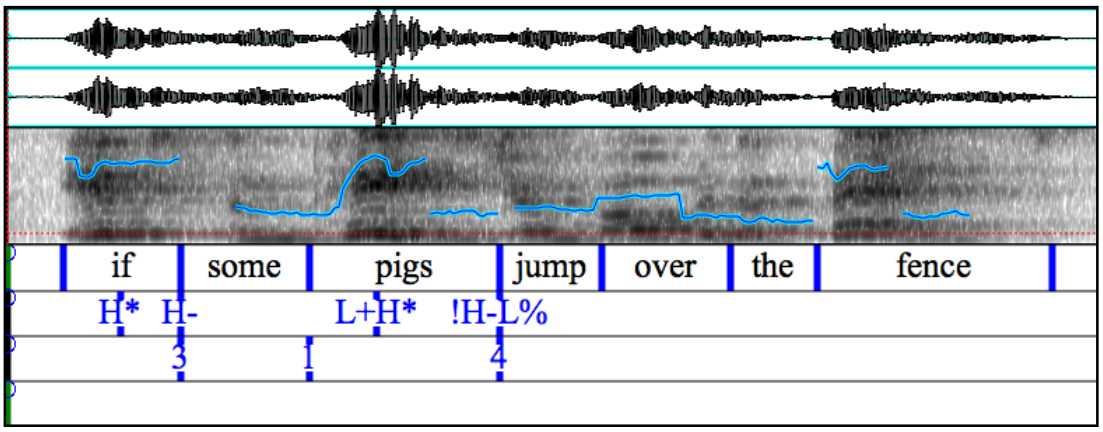
IG: "*Sm* monkeys jumped over the fence"



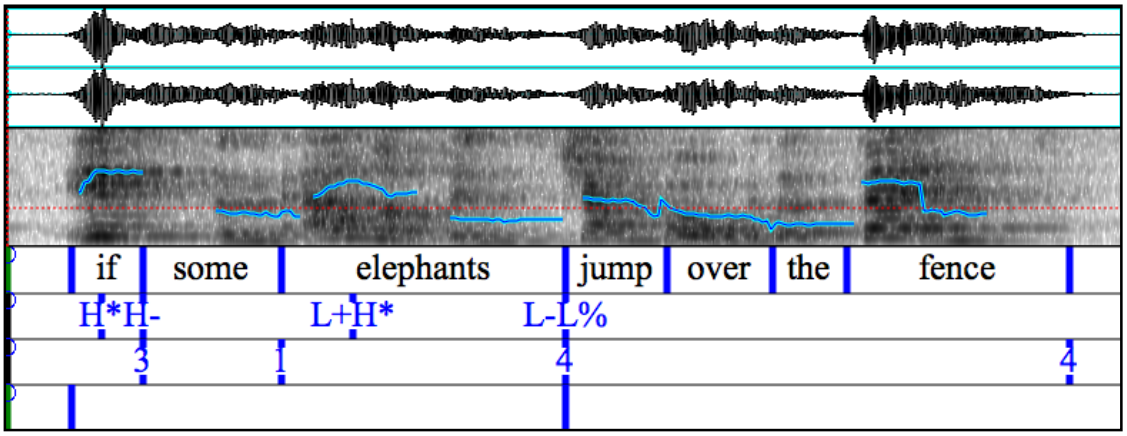
IG: "*Sm* cats jumped over the fence"



DE: “If s*m* pigs jump over the fence”

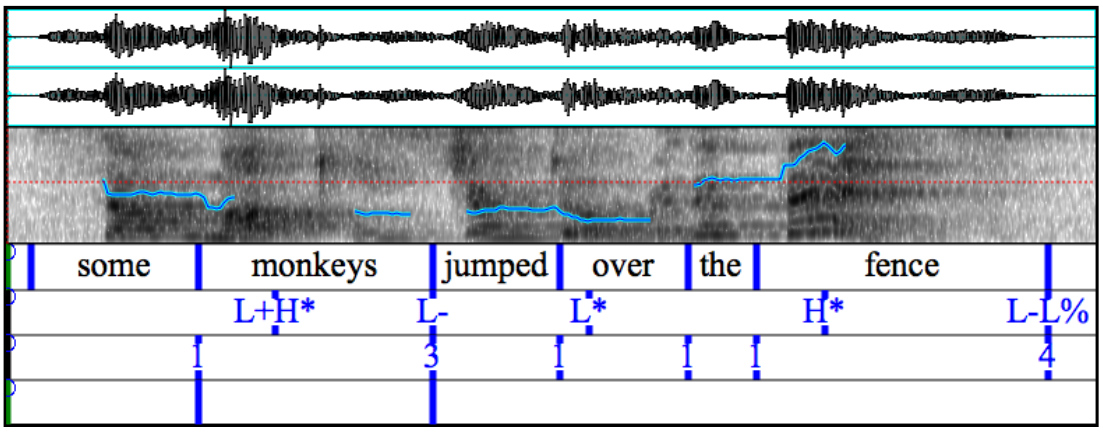


DE: “If s*m* elephants jump over the fence”

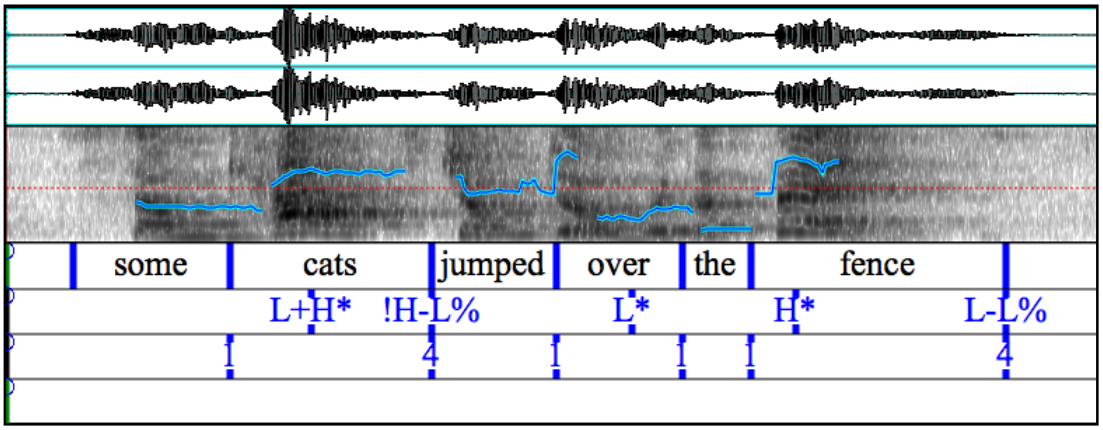


<u>*Some* stimuli sentences:</u>

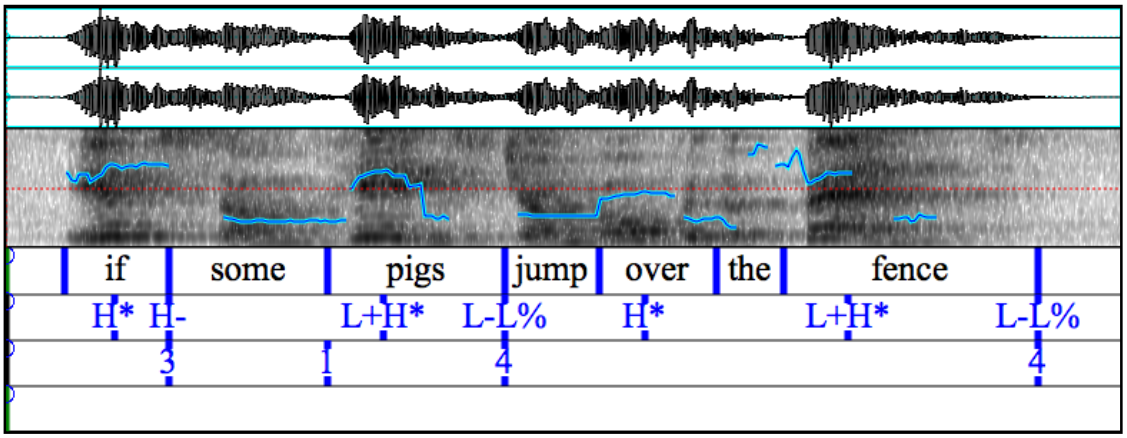
IG: “*Some* monkeys jumped over the fence”



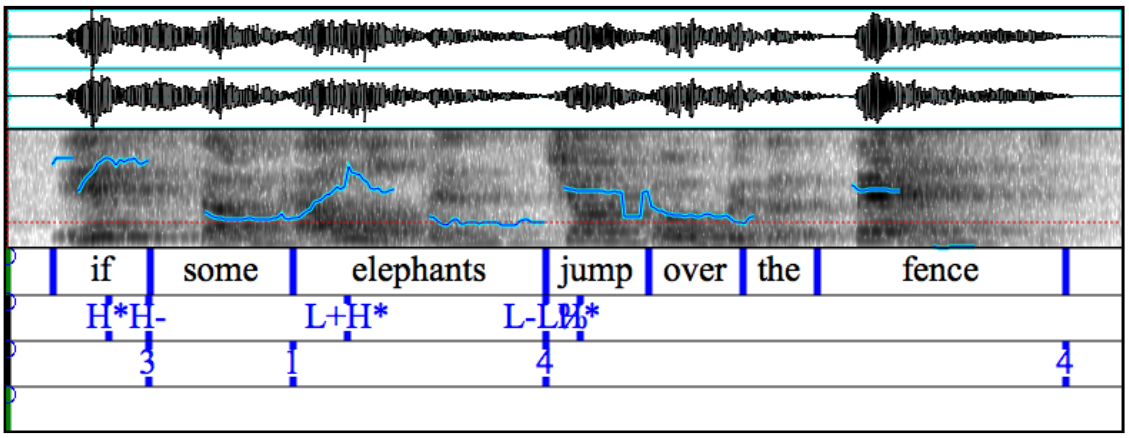
IG: “*Some* cats jumped over the fence”



DE: “If *some* pigs jump over the fence”

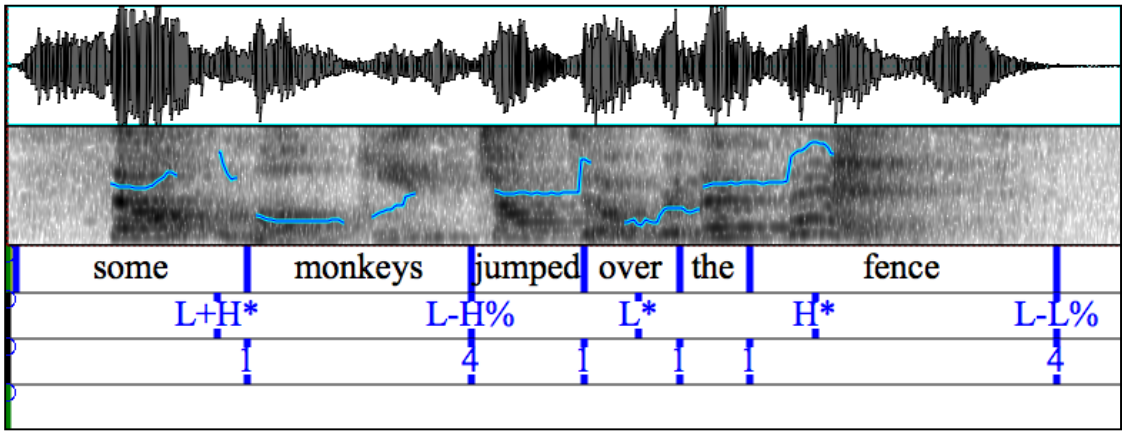


DE: “If *some* elephants jump over the fence”

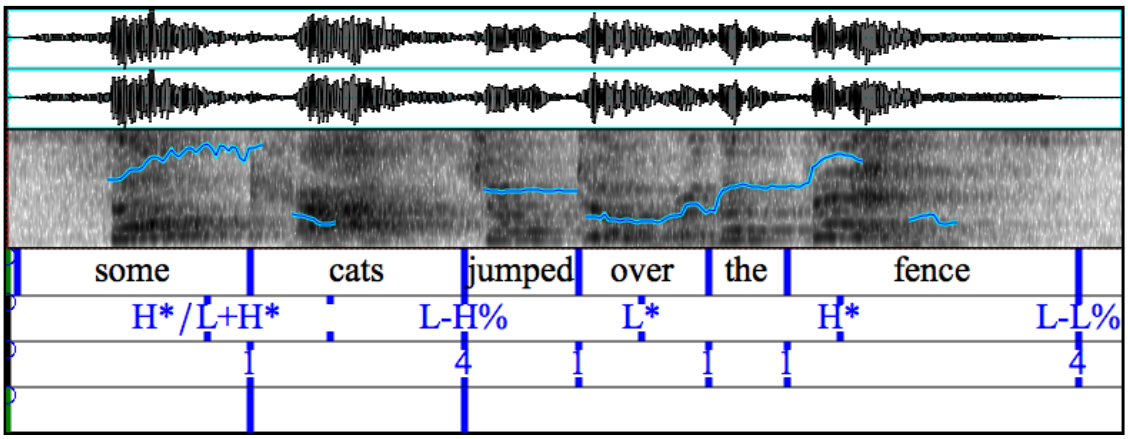


<u>*SOME* stimuli sentences:</u>

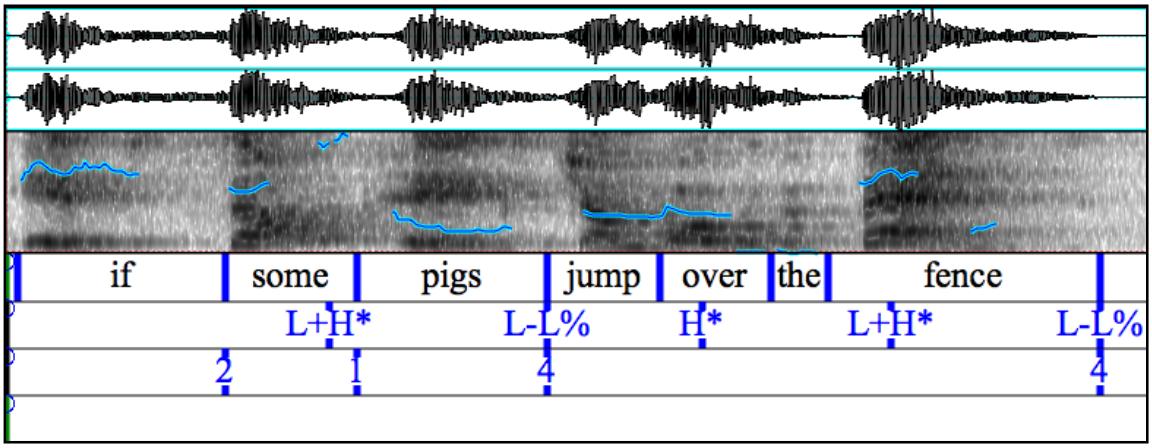
IG: “*SOME* monkeys jumped over the fence”



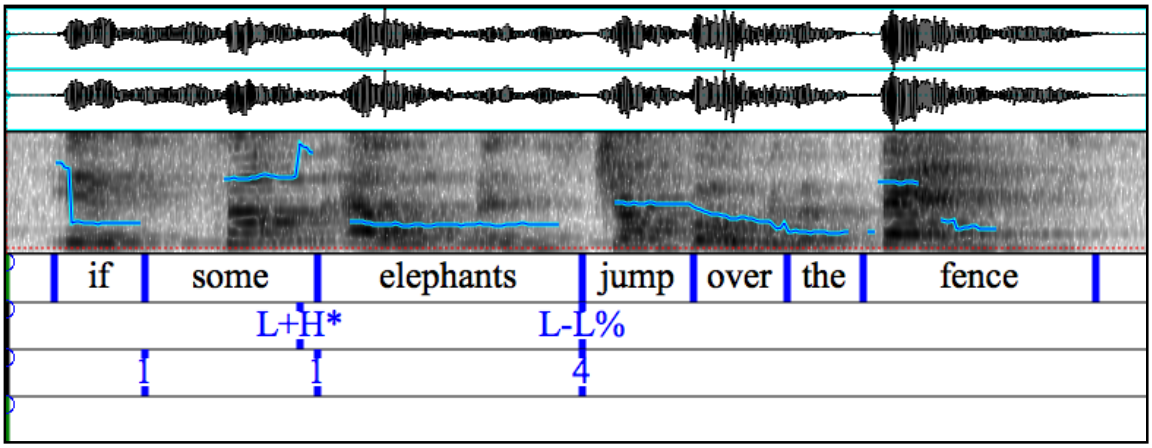
IG: “*SOME* cats jumped over the fence”



DE: “If *SOME* pigs jump over the fence”



DE: “If *SOME* elephants jump over the fence”



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